Port of Seattle

# EAST WATERWAY
# NEAR-END-OF-PIPE STORM DRAIN SOLIDS STUDY
# DATA REPORT
# FINAL

April 1, 2011


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## Acronyms

| Acronym | Definition |
|---|---|
| **2LAET** | second-lowest apparent effects threshold |
| **AES** | atomic emission spectrometry |
| **AET** | apparent effects threshold |
| **AP** | Analytical Perspectives |
| **ARI** | Analytical Resources, Inc. |
| **cPAH** | carcinogenic polycyclic aromatic hydrocarbon |
| **CVAA** | cold vapor atomic absorption |
| **DL** | detection limit |
| **dw** | dry weight |
| **ECD** | electron capture detection |
| **EPA** | US Environmental Protection Agency |
| **EW** | East Waterway |
| **FID** | flame ionization detection |
| **FS** | feasibility study |
| **GC/MS** | gas chromatography/mass spectrometry |
| **HPAH** | high-molecular-weight polycyclic aromatic hydrocarbon |
| **HpCDD** | heptachlorodibenzo-*p*-dioxin |
| **HpCDF** | heptachlorodibenzofuran |
| **HRGC** | high-resolution gas chromatography |
| **HRMS** | high-resolution mass spectrometry |
| **HxCDD** | hexachlorodibenzo-*p*-dioxin |
| **HxCDF** | hexachlorodibenzofuran |
| **ICP** | inductively coupled plasma |
| **ID** | identification |
| **J-qualifier** | estimated concentration |
| **LAET** | lowest apparent effects threshold |
| **LCS** | laboratory control sample |
| **LCSD** | laboratory control sample duplicate |
| **LPAH** | low-molecular-weight polycyclic aromatic hydrocarbon |
| **MS** | matrix spike |

| Acronym | Definition |
|---|---|
| **MSD** | matrix spike duplicate |
| **N-qualifier** | tentative identification |
| **NAD83** | North American Datum of 1983 |
| **nv** | no value |
| **NWTPH-Dx** | Northwest total petroleum hydrocarbons – diesel extractable |
| **OCDD** | octachlorodibenzo-*p*-dioxin |
| **OCDF** | octachlorodibenzofuran |
| **OU** | operable unit |
| **PAH** | polycyclic aromatic hydrocarbon |
| **PCB** | polychlorinated biphenyl |
| **PeCDD** | pentachlorodibenzo-*p*-dioxin |
| **PeCDF** | pentachlorodibenzofuran |
| **Port** | Port of Seattle |
| **PSEP** | Puget Sound Estuary Program |
| **QA/QC** | quality assurance/quality control |
| **QAPP** | quality assurance project plan |
| **RL** | reporting limit |
| **SDG** | sample delivery group |
| **SIM** | selective ion monitoring |
| **SPU** | Seattle Public Utilities |
| **SRI** | supplemental remedial investigation |
| **SSA** | SSA Marine |
| **SVOC** | semi-volatile organic compound |
| **T-18** | Terminal 18 |
| **T-25** | Terminal 25 |
| **T-28** | Terminal 28 |
| **T-30** | Terminal 30 |
| **T-102** | Terminal 102 |
| **T-104** | Terminal 104 |
| **TCDD** | tetrachlorodibenzo-*p*-dioxin |
| **TCDF** | tetrachlorodibenzofuran |
| **TEQ** | toxic equivalent |
| **TOC** | total organic carbon |

| Acronym | Definition |
|---|---|
| **TPH** | total petroleum hydrocarbons |
| **TPH-D** | TPH-diesel and oil |
| **U-qualifier** | not detected at given concentration |
| **Windward** | Windward Environmental LLC |

# 1 Introduction

This data report presents the results of the in-line stormwater solids sampling event for the East Waterway (EW) near-end-of-pipe storm drain solids study, which was conducted at Port of Seattle (Port) terminals located adjacent to the EW operable unit (OU) of the Harbor Island Superfund site in April and June 2010. The EW near-end-of-pipe storm drain solids study is being conducted by the Port as part of an ongoing assessment of potential sources of sediment contamination in the EW. The Port's EW near-end-of-pipe storm drain solids study is a separate effort from the US Environmental Protection Agency (EPA)-required supplemental remedial investigation (SRI) source control evaluation; however, the data resulting from the Port's study will supplement the information currently being used for the SRI evaluation.

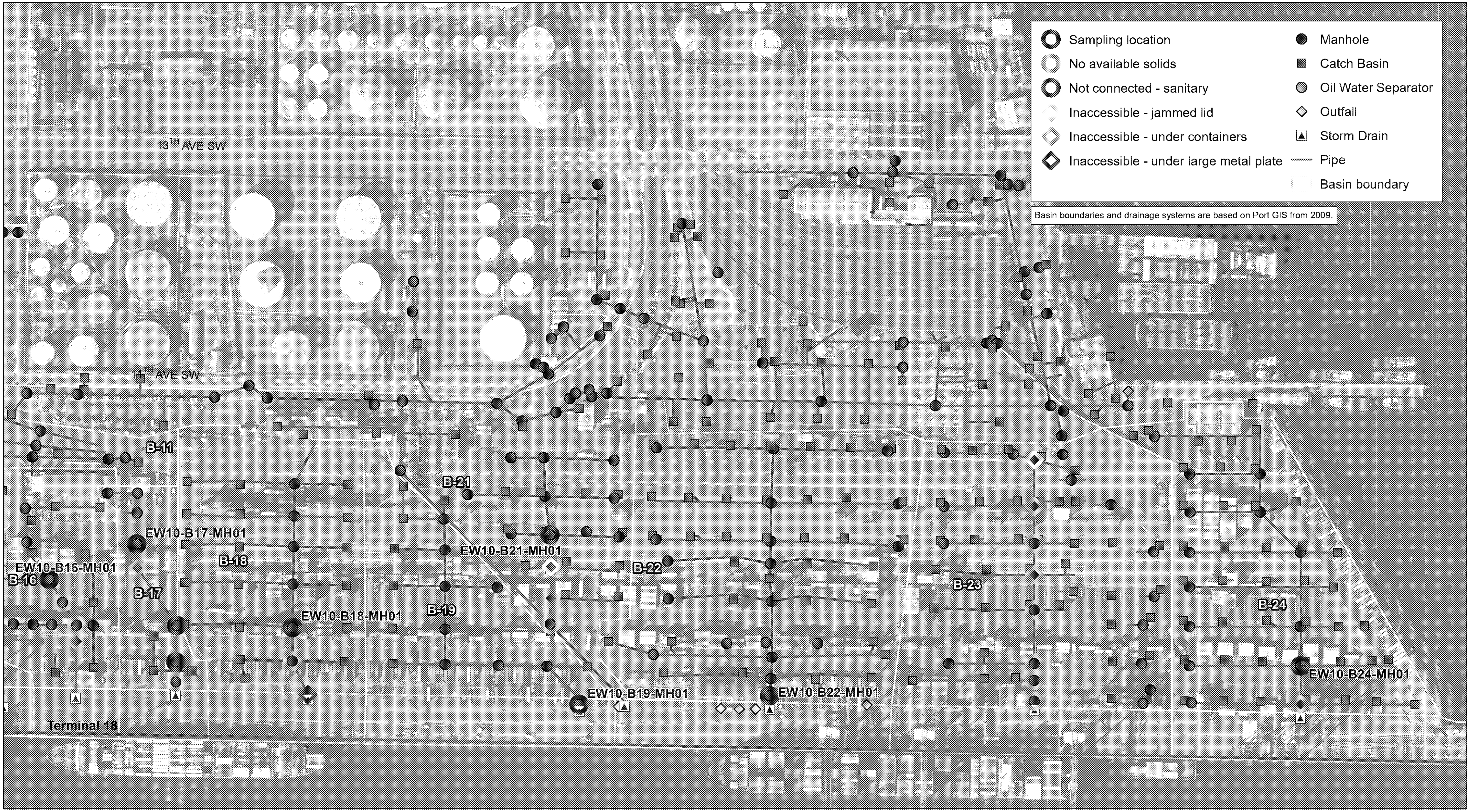
## 1.1 Site Description

The separated stormwater drainage area for the EW is approximately 820 ac (King County and SPU 2004) and includes both private and municipal-separated stormwater discharges. Port properties make up approximately 350 ac of the total EW stormwater drainage area. Port properties with storm drainage to the EW OU include Terminal 18 (T-18), Terminal 25 (T-25), Terminal 30 (T-30), Terminal 102 (T-102), and Terminal 104 (T-104). Storm drainage basins at all of the terminals draining into the EW OU were sampled for this study, including T-18, T-25, T-30, T-102, and T-104. All storm drainage basins draining into the EW OU (Figure 1) were targeted for sampling. Descriptions of the terminals in this study are presented in the following subsections.


**Figure 1. Drainage basins**

### 1.1.1 Terminal 18

T-18 is operated as a container terminal by SSA Marine (SSA). Operations at T-18 include intermodal container storage and loading/unloading, trailer parking, vehicle parking, container equipment maintenance, and equipment parking and fueling. The following drainage basins (Figures 2 and 3) were sampled at T-18: B-7, B-10, B-12, B-13, B-14, B-16, B-17, B-18, B-19, B-21, B-22, and B-24. Basin B-23 was not sampled because of a lack of accumulated solids in accessible maintenance holes. Basin B-11 was sampled by the Port as part of an ongoing sediment trap monitoring program in conjunction with Seattle Public Utilities (SPU) (Windward in prep).




Windward environmental LLC

N

0 300 600 Feet

0 100 200 Meters

**Figure 2. Terminal 18 north sampling locations**


Wind Ward environmental LLC

N

0 300 600 Feet

0 100 200 Meters

**Figure 3. Terminal 18 south sampling locations**

### 1.1.2 Terminal 25

T-25 is operated by SSA as a container terminal. Operations at T-25 include container storage and loading/unloading, trailer parking, vehicle parking, and vehicle fueling and maintenance. The following drainage basins (Figure 4) were sampled at T-25: B-31, B-32, B-33, and B-34.

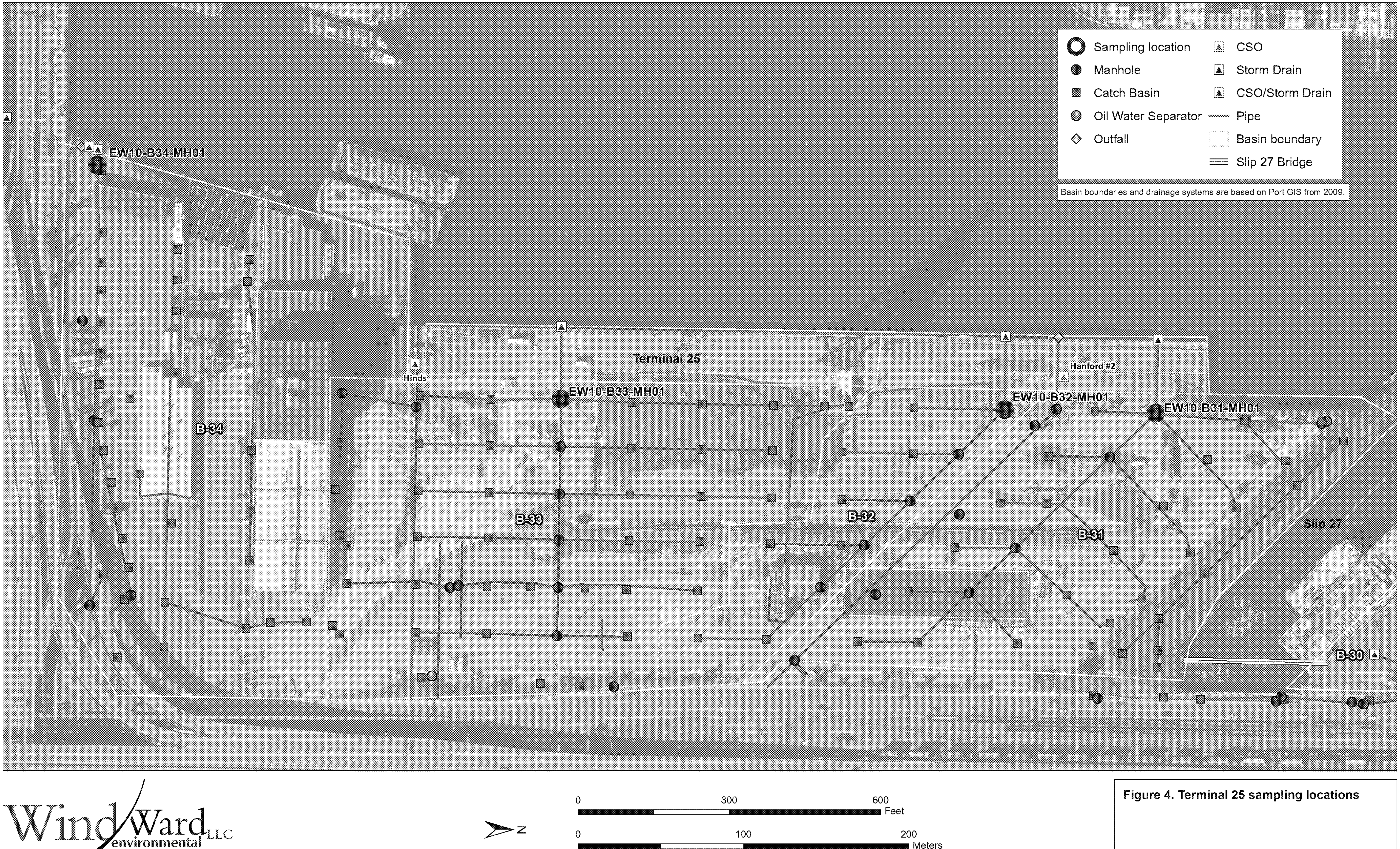



**Figure 4. Terminal 25 sampling locations**

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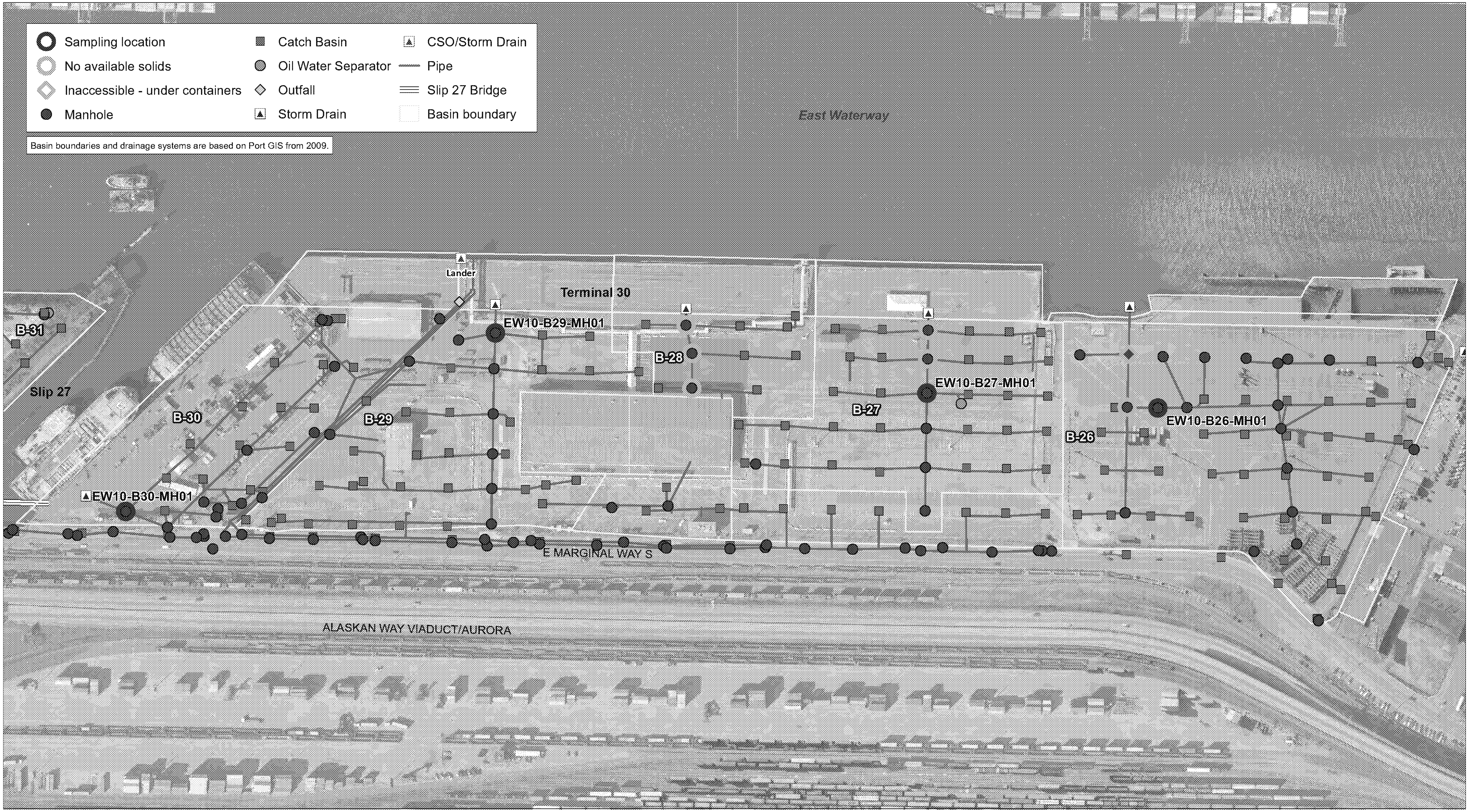
Prepared by craigh, 3/24/2011; W:\Projects\00-08-08 East Waterway\EW-POS support\Data\GIS\Stormwater\Near end of pipe sampling\Fig 4 4229 Near end of pipe sampling locations - T25.mxd

### 1.1.3 Terminal 30

T-30 is operated by SSA as a container terminal. Operations at T-30 include intermodal container storage and loading/unloading, trailer parking, vehicle parking, container equipment maintenance, and container steam cleaning. In early 2009, T-30 was converted from a cruise ship terminal (operated by Cruise Terminals of America) into a container terminal, and expanded to include the former Terminal 28 (T-28) property. The following drainage basins (Figure 5) were sampled at T-30: B-26, B-27, B-29, and B-30. Basin B-28 was not sampled because of a lack of accumulated solids.




N

0 300 600 Feet

0 100 200 Meters

**Figure 5. Terminal 30 sampling locations**

### 1.1.4 Terminal 102

T-102 is an office park and marina located at the southern end of Harbor Island. One drainage basin on the property, B-1, discharges into the EW OU from a vehicle parking lot (Figure 6). Drainage basin B-1 was sampled at T-102.

### 1.1.5 Terminal 104

Until 2009, T-104 was a truck and rail loading station operated by Western Cartage, Seattle Transload, and Seattle Bulk Rail Station, Inc. Operations at T-104 included truck loading/unloading, train loading/unloading, vehicle parking, truck maintenance, warehousing, and equipment pressure washing. The property was vacated in 2009 and is currently occupied by SSA. T-104 is served by two drainage basins, B-37 and B-39, which discharge into the EW OU (Figure 6). Drainage basin B-37 was sampled at T-104, but drainage basin B-39 was not because of a lack of accumulated solids.

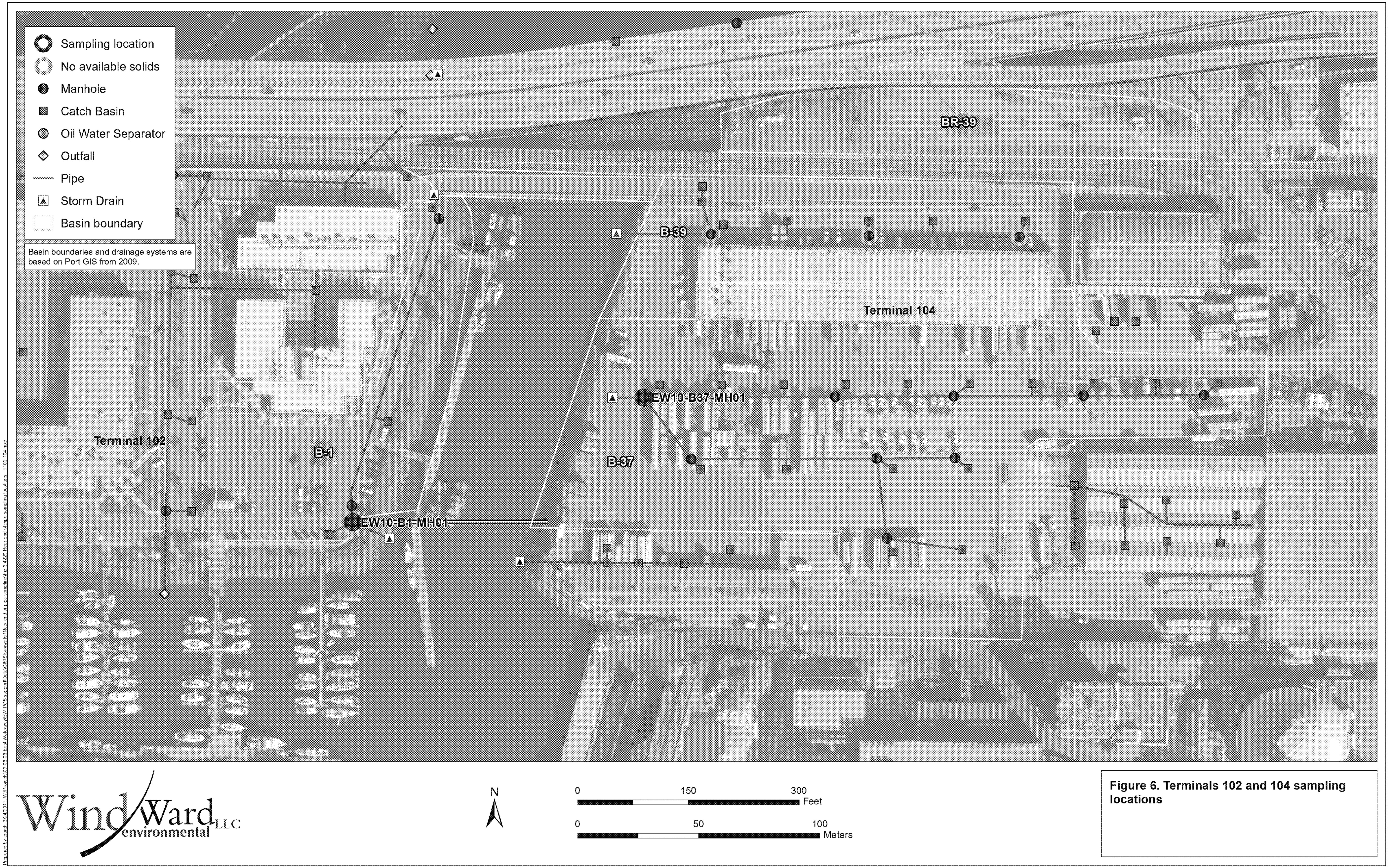



**Figure 6. Terminals 102 and 104 sampling locations**

## 1.2 SAMPLING PROGRAM DESIGN AND BACKGROUND

The primary goals of the near-end-of-pipe storm drain solids sampling program are to inform the ongoing EW source control evaluation being completed as part of the SRI/feasibility study (FS), and to aid in ongoing Port source control efforts. The terminals served by networks that drain to the EW include T-18, T-25, T-30, T-102, and T-104. The objective of the sampling event was to collect solids from all drainage networks at T-18, T-25, T-30, T-102, and T-104 that drain to the EW OU, which are shown on Figure 1. The maintenance hole locations targeted were those nearest the outfalls in order to obtain samples corresponding to the greatest drainage area possible for each network; these samples also best represent the chemical qualities of the materials directly discharged to the waterway from a given drainage system. If an adequate amount of solids was available, samples were analyzed for semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons-diesel and oil (TPH-D), total organic carbon (TOC), total solids, and grain size.

The initial catch basin composite sampling event conducted during the EW storm drain solids study (Windward 2009a) served to characterize solids from surface drainage at Port terminals, and to identify some variability between individual drainage networks. The design of the composite scheme allowed for efficient follow-up source tracing, which characterized the nature of the variability within those basins that had been identified as having elevated concentrations of contaminants (Windward 2009b). In some areas, contaminant concentration varied by individual catch basin (e.g., metals in basin B-32); in other areas, it varied by operational area (e.g., polycyclic aromatic hydrocarbons [PAHs] in Basin B-7, near the main semi-trailer truck entrance). The EW near-end-of-pipe storm drain solids study program evaluates the contributions of all the networks to the EW by sampling in-line solids as near the outfalls as possible; these solids may be used to evaluate potential contributions to the EW from surface drainage.

The Port conducted field reconnaissance at T-18, T-25, T-30, and T-104 in April 2009 to determine the feasibility of obtaining adequate volumes of material from maintenance hole locations near the outfalls at these terminals. The objectives of the reconnaissance were to determine the accessibility of possible sampling locations, the amount of sediment that may be available for sampling, and the appropriate sampling methods.

During the reconnaissance, most of the maintenance holes targeted were accessible and found to have enough material for at least limited analysis. While most locations were considered samplable from the surface, some locations required confined-space entry for sample collection, because of the amounts and locations of solids in the structures.

After results were received from the near-end-of-pipe in-line grab sample analyses, archived samples were chosen for analysis of dioxins/furans. Initially, six composite samples and two discrete basin samples were analyzed for dioxins/furans. Five of the composite samples were created by combining and homogenizing equal amounts of solids from archived near-end-of-pipe in-line grab samples. The other initial composite sample (EWWST7-040110-comp) was composed of equal amounts of solids from the in-line sediment trap sample and the colocated in-line grab sample from basin B-11 at T-18, both of which were collected as part of the Port's ongoing sediment trap monitoring program being conducted in conjunction with SPU (Windward in prep). The initial discrete basin samples (EW10-B16-MH01 and EW10-B34-MH01) were composed of archived material from their associated in-line grab samples.

After the initial dioxin/furan results were received, one additional composite basin sample and four additional discrete basin samples were analyzed to follow up on the initial results. Samples from basins B-1, B-21, B-22, and B-37 were analyzed individually. Equal amounts of sample material from basins B-17, B-18, and B-19 were combined and homogenized to create the composite sample EW10-Bcomp-MH01. The dioxin/furan sample locations, identifications (IDs), and types are listed in Table 1.

### Table 1. Dioxin sample information

| Terminal | Dioxin/furan sample | Type | Basin(s) |
|---|---|---|---|
| T-18 | EW10-B16-MH01 | discrete | B-16 |
| T-18 | EW10-MH-comp2 | composite | B-7, B-10, B-12, B-13, B-14 |
| T-18 | EW10-MH-comp3 | composite | B-17, B-18, B-19, B-21, B-22, B-24 |
| T-18 | EWWST7-040110-comp | composite | B-11 |
| T-18 | EW10-B21-MH01 | discrete | B-21 |
| T-18 | EW10-B22-MH01 | discrete | B-22 |
| T-18 | EW10-Bcomp-MH01 | composite | B-17, B-18, B-19 |
| T-25 | EW10-B34-MH01 | discrete | B-34 |
| T-25 | EW10-MH-comp4 | composite | B-31, B-32, B-33 |
| T-30 | EW10-MH-comp5 | composite | B-26, B-27, B-29, B-30 |
| T-102 and T-104 | EW10-MH-comp1 | composite | B-1, B-37 |
| T-102 | EW10-B1-MH01 | discrete | B-1 |
| T-104 | EW10-B37-MH01 | discrete | B-37 |

T-18 – Terminal 18

T-25 – Terminal 25

T-30 – Terminal 30

T-102 – Terminal 102

T-104 – Terminal 104

# 2 Field Methods

## 2.1 Sample Collection and Processing

Field activities were conducted by Windward Environmental LLC (Windward) and performed under the direction of the field coordinator. One discrete in-line solids sample was collected from each network with available accumulated solids in accessible locations. Samples were collected from 22 of the 26 Port stormwater drainage networks draining into the EW. The remaining four networks were not sampled because of a lack of accumulated solids in accessible locations. The majority (19) of the samples were collected from the bottoms of maintenance holes using a stainless steel cup attached to a telescopic pole. The three other samples (from basins B-27, B-29, and B-30) were collected by confined-space entry personnel using a stainless steel spoon. Each solids sample was placed in a clean stainless steel bowl and homogenized before being placed in the appropriate containers. The general procedure for collecting in-line solids samples is described in greater detail in the quality assurance project plan (QAPP) (Windward 2010).

## 2.2 Field Equipment Decontamination

To prevent cross-contamination between samples, all sample collection and homogenization equipment, including the mixing bowl, stainless steel implements, and collection cup/pole, were decontaminated before being used at the first location and between locations as described in the QAPP (Windward 2010).

## 2.3 Field Quality Assurance/Quality Control

A field duplicate sample was collected to evaluate variability attributable to sample homogenization and subsequent sample handling. The field duplicate sample (EW10-B17-MH101) was collected from the same batch of homogenized material as the original sample (EW10-B17-MH01) and analyzed as a separate sample; this type of field quality assurance/quality control (QA/QC) sample is also referred to as a field split sample (PSEP 1997). The field duplicate sample was documented in the field logbook (Appendix D).

## 2.4 Disposal of Unused Sample Material

Excess solids that remained after each individual in-line grab sample was obtained were returned to the collection location. All disposable sampling materials and personal protective equipment used in sample processing, such as disposable gloves and paper towels, were placed in heavyweight garbage bags, which were placed of in a normal refuse container for disposal as solid waste.

## 2.5 Sample Identification Scheme

Each discrete sample is assigned a unique alphanumeric identifier. The first characters are "EW10-" for the East Waterway project in 2010, followed by the basin identification (e.g., "B7-" or "B26-"). The next characters indicate the sample type, "MH" designating a sample from a maintenance hole. The sample type is followed by a consecutive number beginning with "01." For example, the sample collected from basin B-7 is identified as "EW10-B7-MH01." The field duplicate sample is assigned a unique sample number (EW10-B17-MH101). The sample collected from basin B-21 was mislabeled in the field as EW10-B20-MH01; it is referred to as sample EW10-B21-MH01 in this report.

Dioxin composite sample IDs were assigned modified sample identifiers. As with the discrete samples, the first characters are "EW10-." The next characters indicate the sample type, "MH-" designating sample material from maintenance holes; these characters are followed by "comp" to designate the sample as a composite. The sample type is followed by a consecutive number beginning with "01." There are five composite samples labeled with this system. A sixth composite sample is labeled "EW10-040110-comp." EW10-040110-comp is a composite of a sediment trap sample and colocated in-line grab sample sediments from basin B-11, which were collected as part of a separate, ongoing sediment trap monitoring program the Port is conducting in conjunction with SPU (Windward in prep). A seventh composite sample for dioxin analysis was assigned the ID EW10-Bcomp-MH01; this sample's ID format is different because it was sent in a separate analysis batch at a later date.

## 2.6 Sample Documentation Procedures

A field logbook and field forms were used to note the dates, times, and locations of sampling stations, as well as additional parameters recorded in the field (see Appendix D), for each sample. The following data were recorded in the field logbook:

- Names of field coordinators and person(s) collecting and logging the samples
- Unique sample and location identifiers
- Date and time of collection
- Observations made during sample collection, including weather conditions, complications, and other details associated with sampling equipment or procedures

The following additional information was recorded on the solids collection field forms:

- Sample location coordinates
- Sampling method
- Nearby site activities/uses

- Observations of solids, including the presence of foreign objects, color of solids, presence of sheen, apparent grain size, and odor

## 2.7 Chain of Custody and Sample Transport Procedures

Custody procedures were initiated during sediment sample collection. Chain of custody forms were used to track sample custody. Completed forms are included in Appendix E. Samples collected in the field were placed in a cooler with ice and hand delivered to Analytical Resources, Inc. (ARI), in Tukwila, Washington.

# 3 Laboratory Methods

The methods and procedures used to chemically analyze the samples are described briefly in this section and in detail in the QAPP (Windward 2010). ARI conducted chemical and physical testing of each discrete in-line solids sample. All in-line solids samples were analyzed by ARI for SVOCs, total metals, PCBs (as Aroclors), total solids, TPH-D, TOC, and grain size. Analytical Perspectives (AP) in Wilmington, North Carolina, conducted dioxin/furan analyses on seven in-line solids composite samples and six discrete in-line solids samples.

## 3.1 Analytical Methods

The chemical and physical analytical methods selected for use in the near-end-of-pipe storm drain solids study represent standard methods used for the analysis of these parameters in sediments. Table 2 summarizes the specific methods used to analyze the samples.

## Table 2. Summary of analytical methods

| Parameter | Method | Source |
|---|---|---|
| SVOCs | GC/MS | EPA 8270D |
| Select SVOCs[a] | GC/MS-SIM | EPA 8270D-SIM |
| PCBs as Aroclors | GC/ECD | EPA 8082 |
| Mercury | CVAA | EPA 7471A |
| Other metals[b] | ICP-AES or ICP-MS | EPA 6010B or EPA 200.8 |
| TPH-D | GC/FID | NWTPH-Dx |
| Dioxins/furans | HRGC/HRMS | EPA 1613B |
| TOC | combustion | Plumb (1981) |
| Total solids | oven-dried | EPA 160.3 |
| Grain size | sieve/pipette | PSEP (1986) |

[a] Select SVOCs include 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethylphenol, 2-methylphenol, benzyl alcohol, butyl benzyl phthalate, dibenz(a,h)anthracene, di-methyl phthalate, hexachlorobenzene, hexachlorobutadiene, n-nitrosodimethylamine, n-nitrosodiphenylamine, n-nitrosodi-n-propylamine, and pentachlorophenol.

[b] Arsenic, cadmium, chromium, copper, lead, silver, and zinc.

AES – atomic emission spectrometry
CVAA – cold vapor atomic absorption
ECD – electron capture detection
EPA – US Environmental Protection Agency
FID – flame ionization detection
GC/MS –gas chromatography/mass spectrometry
HRGC – high-resolution gas chromatography
HRMS – high-resolution mass spectrometry
ICP – inductively coupled plasma
NWTPH-Dx – Northwest total petroleum hydrocarbons – diesel extractable
PCB – polychlorinated biphenyl
PSEP – Puget Sound Estuary Program
SIM – selected ion monitoring
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH-D – total petroleum hydrocarbons

## 3.2. DIOXIN/FURAN SAMPLE COMPOSITING

The seven composite samples for dioxin/furan analysis were created by ARI by combining and homogenizing equal masses of material from each discrete subsample. The seven homogenized composite samples and the six discrete samples were sent to AP to be analyzed for dioxins/furans using the methods listed in Table 2.

# 4 Results

Locations and descriptions of the in-line solids samples are provided in Section 4.1. Analytical results of the samples are summarized in Sections 4.2 and 4.3. These analytical results have undergone summary-level data validation, as described in detail in Appendix C. The results presented in this report are of good quality and are considered acceptable for all project uses, as qualified. All chemistry results are presented and compared to 1988 apparent effects threshold (AET) values in Section 4.3. These comparisons are for screening purposes only and do not imply that the values listed in Section 4.1 are necessarily applicable to storm drain solids. Laboratory data report forms are provided in Appendix A.

Field duplicate results are presented independently from the samples from which the field duplicates were derived. Significant figure rules were applied when summing duplicate totals. A detailed discussion of the hierarchical approach used in averaging laboratory replicates and calculating totals, as well as the application of significant figures, is presented in Appendix B.

## 4.1 Sampling Locations and Sample Characteristics

The near-end-of-pipe in-line solids sampling locations and descriptions are presented in Table 3. All samples were collected from maintenance hole structures, with the exception of sample EW10-B1-MH01, which was collected from an in-line catch basin structure directly before the outfall in basin B-1. All coordinates are reported as geographic (North American Datum of 1983 [NAD83], degrees) coordinates.

## Table 3. Near-end-of-pipe in-line solids sample locations and descriptions

| Terminal | Sample ID | Date | Time | Latitude | Longitude | Solids Characteristics |
|---|---|---|---|---|---|---|
| T-102 | EW10-B1-MH01 | 4/22/2010 | 8:10 | 47.56948 | -122.34670 | Gray silt and fine sand with organic matter and sheen. Moderate H2S odor. |
| T-18 | EW10-B7-MH01 | 4/22/2010 | 15:00 | 47.57385 | -122.34769 | Brown silt and sand with gravel and sheen. No odor. |
| | EW10-B10-MH01 | 4/22/2010 | 14:20 | 47.57685 | -122.34655 | Gray silt and sand with sheen. Moderate petroleum odor. |
| | EW10-B12-MH01 | 4/22/2010 | 15:55 | 47.57787 | -122.34675 | Gray silt and sand with sheen. No odor. |
| | EW10-B13-MH01 | 4/22/2010 | 13:30 | 47.57906 | -122.34650 | Brown sand with sheen. No odor. |
| | EW10-B14-MH01 | 4/22/2010 | 13:00 | 47.57955 | -122.34664 | Brown silt and sand with orange iron staining. No odor. |
| | EW10-B16-MH01 | 4/22/2010 | 11:00 | 47.57990 | -122.34747 | Brown silt and sand with no odor. |
| | EW10-B17-MH01 | 4/22/2010 | 10:15 | 47.58083 | -122.34806 | Gray silt and sand with sheen. Moderate petroleum odor. |
| | EW10-B18-MH01 | 4/22/2010 | 10:15 | 47.58201 | -122.34706 | Brown sand with sheen. No odor. |
| | EW10-B19-MH01 | 4/22/2010 | 9:40 | 47.58394 | -122.34652 | Brown silt and sand with sheen. No odor. |
| | EW10-B20-MH01 | 4/22/2010 | 9:00 | 47.58373 | -122.34822 | Brown silt and sand with sheen. No odor. |
| | EW10-B22-MH01 | 4/22/2010 | 12:30 | 47.58526 | -122.34673 | Brown silt and sand with gravel and sheen. No odor. |
| | EW10-B24-MH01 | 4/22/2010 | 15:30 | 47.58922 | -122.34702 | Gray silt and sand with no odor. |
| T-30 | EW10-B26-MH01 | 4/20/2010 | 9:15 | 47.58628 | -122.34160 | Drab olive silt and fine sand with sheen. No odor. |
| | EW10-B27-MH01 | 6/3/2010 | 9:30 | 47.58472 | -122.34173 | Gray silt and sand with gravel. No odor. |
| | EW10-B29-MH01 | 6/3/2010 | 14:10 | 47.58173 | -122.34226 | Gray silt and sand with gravel, organic matter, and sheen. No odor. |
| | EW10-B30-MH01 | 6/3/2010 | 13:20 | 47.57920 | -122.34036 | Gray silt, clay, and sand with no odor. |
| T-25 | EW10-B31-MH01 | 4/20/2010 | 13:40 | 47.57769 | -122.34242 | Gray silt and sand with no odor. |
| | EW10-B32-MH01 | 4/20/2010 | 14:10 | 47.57693 | -122.34244 | Gray silt and sand with no odor. |
| | EW10-B33-MH01 | 4/20/2010 | 13:05 | 47.57455 | -122.34249 | Gray silt and sand with sheen. No odor. |
| | EW10-B34-MH01 | 4/20/2010 | 12:40 | 47.57197 | -122.34420 | Gray silt and sand with sheen. No odor. |
| T-104 | EW10-B37-MH01 | 4/20/2010 | 14:50 | 47.57693 | -122.34508 | Black silt and sand with organic matter and sheen. Strong petroleum odor. |

Note: Coordinates listed are geographic (NAD83, degrees) coordinates.

ID – identification

NAD83 – North American Datum of 1983

T-18 – Terminal 18

T-25 – Terminal 25

T-30 – Terminal 30

T-102 – Terminal 102

T-104 – Terminal 104

## 4.2 PHYSICAL ANALYSIS RESULTS

Table 4 presents grain size and total solids analyses results for the near-end-of-pipe in-line solids samples. The laboratory reports for grain size and total solids analyses are presented in Appendix A.

### Table 4. Sediment grain size and total solids results

| Sample ID | % Gravel | % Sand | % Silt | % Clay | % Fines[a] | % Solids |
|---|---|---|---|---|---|---|
| EW10-B1-MH01 | 4.1 | 52.2 | 32.4 | 11.2 | 43.6 | 54.00 |
| EW10-B7-MH01 | 58.3 | 36.4 | 4.3 | 0.9 | 5.2 | 84.60 |
| EW10-B10-MH01 | 21.7 | 55.9 | 18.5 | 3.9 | 22.4 | 62.10 |
| EW10-B12-MH01 | na | na | na | na | na | 56.40 |
| EW10-B13-MH01 | 0.5 | 96.7 | na | na | na | 71.70 |
| EW10-B14-MH01 | 0.1 | 95.3 | na | na | na | 69.80 |
| EW10-B16-MH01 | 26.8 | 30.5 | 30.1 | 12.6 | 42.7 | 46.40 |
| EW10-B17-MH01/ EW10-B17-MH101 | 3 | 77 | 17.5 | 3 | 20 | 69.90 |
| EW10-B18-MH01 | 26.9 | 69.6 | na | na | na | 82.10 |
| EW10-B19-MH01 | 21.9 | 73.2 | 3.7 | 1.3 | 5.0 | 77.80 |
| EW10-B20-MH01 | 1.5 | 55.5 | 36.3 | 6.6 | 42.9 | 64.90 |
| EW10-B22-MH01 | 47.1 | 49.6 | na | na | na | 75.60 |
| EW10-B24-MH01 | 4.4 | 25.6 | 48.4 | 21.5 | 69.9 | 53.30 |
| EW10-B26-MH01 | 15.6 | 39.0 | 35.7 | 9.7 | 45.4 | 50.27 |
| EW10-B27-MH01 | 29.6 | 63.0 | 5.4 | 1.9 | 7.3 | 74.17 |
| EW10-B29-MH01 | 51.2 | 41.1 | 6.2 | 1.7 | 7.9 | 74.30 |
| EW10-B30-MH01 | 48.5 | 25.0 | 19.7 | 6.8 | 26.5 | 63.50 |
| EW10-B31-MH01 | 5.3 | 87.9 | 5.3 | 1.5 | 6.8 | 75.60 |
| EW10-B32-MH01 | 10.2 | 85.1 | 3.3 | 1.3 | 4.6 | 76.70 |
| EW10-B33-MH01 | 10.2 | 78.8 | 8.4 | 2.7 | 11.1 | 71.60 |
| EW10-B34-MH01 | 2 | 9.7 | 63.5 | 24.9 | 88.4 | 52.30 |
| EW10-B37-MH01 | 1.2 | 27.8 | 65.5 | 5.4 | 70.9 | 45.40 |

[a] Percent fines is calculated as the sum of percent silt and percent clay.

ID – identification

na – not analyzed

## 4.3 CHEMICAL ANALYSIS RESULTS

Tables 5 and 6 summarize the near-end-of-pipe in-line solids analytical results for metals, SVOCs, PCBs (as Aroclors), TPH, and TOC compared to the lowest and second-lowest AET (LAET and 2LAET) values from 1988. These comparisons are for screening purposes only and do not imply that the values listed in Tables 5 and 6 are necessarily applicable to storm drain solids. Table 7 summarizes the results for the dioxin/furan samples, and Figure 7 presents the TEQs and the sample coverage. The toxic equivalents (TEQs) for dioxin/furan results are calculated using World Health Organization 2005 guidance (Van den Berg et al. 2006). The laboratory reports for the chemical analyses are presented in Appendix A.

## Table 5. Terminals 18 and 102 near-end-of-pipe in-line solids chemical analyses results

| Chemical | LAET | 2LAET | Unit | Basin B-1 EW10-B1-MH01 | Basin B-7 EW10-B7-MH01 | Basin B-10 EW10-B10-MH01 | Basin B-12 EW10-B12-MH01 | Basin B-13 EW10-B13-MH01 | Basin B-14 EW10-B14-MH01 | Basin B-16 EW10-B16-MH01 | Basin B-17 EW10-B17-MH01/ EW10-B17-MH101 | Basin B-18 EW10-B18-MH01 | Basin B-19 EW10-B19-MH01 | Basin B-21 EW10-B21-MH01[a] | Basin B-22 EW10-B22-MH01 | Basin B-24 EW10-B24-MH01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | | | | | | | | | |
| Arsenic | 57 | 93 | mg/kg dw | 15 | 10 | 12 | 14 | 6 U | 8 | 30 | 8 | 6 U | 20 U | 12 | 20 U | 31 |
| Cadmium | 5.1 | 6.7 | mg/kg dw | 2.0 | 0.5 | 1.2 | 1.0 | 0.3 U | 0.3 U | 1.3 | 1.8 | 0.4 | 0.9 | 1.9 | 0.9 | 1.1 |
| Chromium | 260 | 270 | mg/kg dw | 54.5 | 31.3 | 72.6 | 84.4 | 16.0 | 12.0 | 103 | 64 | 42.5 | 61 | 82.0 | 66 | 89.8 |
| Copper | 390 | 390 | mg/kg dw | 130 | 69.2 | 93.1 | **688** | 20.5 | 15.1 | 246 | 124 | 351 | 136 | 178 | 62.8 | 367 |
| Lead | 450 | 530 | mg/kg dw | 213 | 30 | 99 | 132 | 22 | 15 | **463** | 81 | 42 | 50 | 258 | 45 | **724** |
| Mercury | 0.41 | 0.59 | mg/kg dw | 0.13 | 0.03 | 0.07 | 0.04 | 0.02 U | 0.03 U | 0.26 | 0.05 | 0.02 U | 0.02 U | 0.14 | 0.04 | **0.44** |
| Silver | 6.1 | nv | mg/kg dw | 0.5 U | 0.3 U | 0.5 U | 0.5 U | 0.4 U | 0.4 U | 0.6 U | 0.4 U | 0.4 U | 1 U | 0.5 U | 0.9 U | 0.6 U |
| Zinc | 410 | 960 | mg/kg dw | **480** | 296 | **1,180** | **964** | 200 | 47 | **1,520** | **1,300** | **782** | **715** | **1,930** | **566** | **2,130** |
| **PAHs** | | | | | | | | | | | | | | | | |
| 1-Methylnaphthalene | nv | nv | µg/kg dw | 94 | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 96 J | 51 U | 91 U |
| 2-Chloronaphthalene | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| 2-Methylnaphthalene | 670 | 670 | µg/kg dw | 100 | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 94 J | 51 U | 91 U |
| Acenaphthene | 500 | 500 | µg/kg dw | 170 | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 150 | 51 U | 91 U |
| Acenaphthylene | 1,300 | 1,300 | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| Anthracene | 960 | 960 | µg/kg dw | **1,000** | 28 J | 72 J | 100 | 39 U | 39 U | 80 J | 44 J | 39 U | 39 U | 110 J | 51 U | 47 J |
| Benzo(a)anthracene | 1,300 | 1,600 | µg/kg dw | 370 | 86 | 290 | 220 | 39 U | 24 J | 150 | 130 | 39 U | 51 | 190 | 66 | 160 J |
| Benzo(a)pyrene | 1,600 | 1,600 | µg/kg dw | 440 J | 78 | 210 | 100 U | 22 J | 20 J | 95 U | 460 | 40 | 57 J | 120 U | 83 J | 300 J |
| Benzo(g,h,i)perylene | 670 | 720 | µg/kg dw | 270 J | 87 | 260 | 230 | 21 J | 22 J | 570 | 190 | 37 J | 65 J | 420 | 62 J | 340 J |
| Total benzofluoranthenes | 3,200 | 3,600 | µg/kg dw | 1,200 | 200 | 680 | 480 | 50 J | 48 J | 1,080 | 510 | 72 J | 152 | 1,000 | 142 | 680 |
| Chrysene | 1,400 | 2,800 | µg/kg dw | 960 | 240 | 690 | 560 | 38 J | 25 J | 680 | 540 | 99 | 140 | 1,000 | 190 | 330 |
| Dibenzo(a,h)anthracene | 230 | 230 | µg/kg dw | 95 J | 40 U | 91 U | 100 U | 39 U | 39 UJ | 75 J | 84 U | 39 U | 39 U | 130 | 51 U | 91 U |
| Dibenzofuran | 540 | 540 | µg/kg dw | 150 | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 82 J | 51 U | 91 U |
| Fluoranthene | 1,700 | 2,500 | µg/kg dw | **3,900** | 360 | 700 | 680 | 30 J | 48 | 870 | 480 | 78 | 190 | 1,300 | 180 | 610 |
| Fluorene | 540 | 540 | µg/kg dw | 360 | 40 UJ | 91 UJ | 57 J | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 85 J | 51 U | 91 U |
| Indeno(1,2,3-cd)pyrene | 600 | 690 | µg/kg dw | 220 J | 27 J | 110 | 100 | 39 U | 39 UJ | 260 | 81 J | 39 U | 39 U | 200 | 51 U | 170 J |
| Naphthalene | 2,100 | 2,100 | µg/kg dw | 95 | 40 UJ | 57 J | 100 UJ | 39 U | 39 U | 95 U | 50 J | 39 U | 22 J | 62 J | 51 U | 91 U |
| Phenanthrene | 1,500 | 1,500 | µg/kg dw | 1,200 | 140 | 200 J | 350 | 39 U | 39 U | 300 | 210 | 30 J | 52 | 620 | 68 | 250 |
| Pyrene | 2,600 | 3,300 | µg/kg dw | 1,100 | 270 | 360 | 520 | 30 J | 39 | 420 | 250 | 68 | 140 | 760 | 130 | 290 J |
| Total HPAHs | 12,000 | 17,000 | µg/kg dw | 8600 J | 1350 J | 3,300 | 2,790 | 191 J | 226 J | 4110 J | 2620 J | 394 J | 800 J | 5,000 | 850 J | 2880 J |
| Total LPAHs | 5,200 | 5,200 | µg/kg dw | 2,800 | 170 J | 330 J | 510 J | 39 U | 39 U | 380 J | 300 J | 30 J | 74 J | 1,030 J | 68 | 300 J |
| cPAHs - mammal - half DL | nv | nv | µg/kg dw | 670 J | 120 J | 340 | 160 | 39 J | 37 J | 230 J | 560 J | 60 | 88 J | 260 | 120 J | 420 J |
| Total PAHs | nv | nv | µg/kg dw | 11400 J | 1520 J | 3630 J | 3300 J | 191 J | 226 J | 4490 J | 2920 J | 424 J | 870 J | 6000 J | 920 J | 3180 J |
| **Phthalates** | | | | | | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 1,300 | 1,900 | µg/kg dw | **11,000** | 980 | **11,000** | **7,100** | **19,000** | 71 U | **2,000** | **5,200** | 510 | **1,400** | **6,700** | **1,600** | **3,100** |
| Butyl benzyl phthalate | 63 | 900 | µg/kg dw | **250 J** | **820** | **2,500** | **1,100** | **420 J** | **83 J** | **510** | **2,700** | **420** | **940** | **2,900** | **23,000** | **400** |
| Diethyl phthalate | 200 | nv | µg/kg dw | 32 U | 20 U | 18 U | 100 UJ | 15 U | 15 U | 15 U | 15 U | 15 U | 15 U | 21 U | 45 U | 15 U |

| Chemical | LAET | 2LAET | Unit | Basin B-1<br>EW10-B1-MH01 | Basin B-7<br>EW10-B7-MH01 | Basin B-10<br>EW10-B10-MH01 | Basin B-12<br>EW10-B12-MH01 | Basin B-13<br>EW10-B13-MH01 | Basin B-14<br>EW10-B14-MH01 | Basin B-16<br>EW10-B16-MH01 | Basin B-17<br>EW10-B17-MH01/<br>EW10-B17-MH101 | Basin B-18<br>EW10-B18-MH01 | Basin B-19<br>EW10-B19-MH01 | Basin B-21<br>EW10-B21-MH01[a] | Basin B-22<br>EW10-B22-MH01 | Basin B-24<br>EW10-B24-MH01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dimethyl phthalate | 71 | 160 | µg/kg dw | 48 | **96 J** | **150 J** | **100 UJ** | 15 U | 15 U | 48 J | **400** | 15 U | **120** | 52 | 45 U | 50 |
| Di-n-butyl phthalate | 1,400 | 1,400 | µg/kg dw | 120 | 40 U | 91 UJ | 100 | 39 U | 39 U | 97 | 120 | 39 U | 39 U | 210 | 51 U | 110 |
| Di-n-octyl phthalate | 6,200 | nv | µg/kg dw | 600 | 40 U | 91 U | 100 U | 21 J | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| **Other SVOCs** | | | | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 31 | 51 | µg/kg dw | 6.1 U | 6.1 U | 6.0 U | **100 UJ** | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | 18 U | 5.9 U |
| 1,2-Dichlorobenzene | 35 | 50 | µg/kg dw | 6.1 U | 6.1 U | 6.0 U | **100 UJ** | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | 18 U | 5.9 U |
| 1,3-Dichlorobenzene | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| 1,4-Dichlorobenzene | 110 | 110 | µg/kg dw | 6.1 U | 6.1 U | 6.0 | 100 UJ | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | 18 U | 6.5 |
| 2,4,5-Trichlorophenol | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 2,4,6-Trichlorophenol | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 2,4-Dichlorophenol | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 2,4-Dimethylphenol | 29 | 29 | µg/kg dw | 6.1 U | 6.1 U | 6.0 U | **100 UJ** | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | 18 U | 5.9 U |
| 2,4-Dinitrophenol | nv | nv | µg/kg dw | 730 U | 400 UJ | 910 UJ | 1,000 UJ | 390 U | 390 U | 950 U | 840 U | 390 U | 390 U | 1,200 U | 510 U | 910 U |
| 2,4-Dinitrotoluene | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 2,6-Dinitrotoluene | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 2-Chlorophenol | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| 2-Methylphenol | 63 | 63 | µg/kg dw | 6.1 U | 6.1 U | 6.0 U | **100 UJ** | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | 18 U | 5.9 U |
| 2-Nitroaniline | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 2-Nitrophenol | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| 3,3'-Dichlorobenzidine | nv | nv | µg/kg dw | 370 U | 200 U | 460 U | 500 U | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 3-Nitroaniline | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 4,6-Dinitro-o-cresol | nv | nv | µg/kg dw | 730 U | 400 U | 910 UJ | 1,000 U | 390 U | 390 U | 950 U | 840 U | 390 U | 390 U | 1,200 U | 510 U | 910 U |
| 4-Bromophenyl phenyl ether | nv | nv | µg/kg dw | 73 U | 40 U | 91 UJ | 100 U | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| 4-Chloro-3-methylphenol | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 4-Chloroaniline | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 4-Chlorophenyl phenyl ether | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| 4-Methylphenol | 670 | 670 | µg/kg dw | 70 J | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | **1,200** | 39 U | 39 U | 120 U | 51 U | 91 U |
| 4-Nitroaniline | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| 4-Nitrophenol | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |
| Aniline | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| Benzoic acid | 650 | 650 | µg/kg dw | **730 U** | 400 UJ | **910 UJ** | **1,000 UJ** | 390 U | 390 U | **950 U** | **840 U** | 390 U | 390 U | **1,200 U** | 510 U | 200 J |
| Benzyl alcohol | 57 | 73 | µg/kg dw | 30 U | 30 U | **420** | **100 UJ** | 30 U | 30 U | 31 U | 49 | **60** | **160** | **270** | **240** | 30 U |
| bis(2-chloroethoxy)methane | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| bis(2-chloroethyl)ether | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| bis(2-chloroisopropyl)ether | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| Carbazole | nv | nv | µg/kg dw | 240 | 40 U | 91 UJ | 80 J | 39 U | 39 U | 55 J | 84 U | 39 U | 39 U | 72 J | 51 U | 91 U |
| Hexachlorobenzene | 22 | 70 | µg/kg dw | 6.1 U | 6.1 U | 6.0 U | **100 U** | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | 18 U | 5.9 U |
| Hexachlorobutadiene | 11 | 120 | µg/kg dw | 6.1 U | 6.1 U | 6.0 U | **100 UJ** | 6.1 U | 6.0 U | 6.1 U | 5.9 U | 6.1 U | 6.1 U | 6.4 U | **18 U** | 5.9 U |
| Hexachlorocyclopentadiene | nv | nv | µg/kg dw | 370 U | 200 UJ | 460 UJ | 500 UJ | 200 U | 190 U | 480 U | 420 U | 200 U | 190 U | 590 U | 250 U | 460 U |

| Chemical | LAET | 2LAET | Unit | Basin B-1 EW10-B1-MH01 | Basin B-7 EW10-B7-MH01 | Basin B-10 EW10-B10-MH01 | Basin B-12 EW10-B12-MH01 | Basin B-13 EW10-B13-MH01 | Basin B-14 EW10-B14-MH01 | Basin B-16 EW10-B16-MH01 | Basin B-17 EW10-B17-MH01/ EW10-B17-MH101 | Basin B-18 EW10-B18-MH01 | Basin B-19 EW10-B19-MH01 | Basin B-21 EW10-B21-MH01[a] | Basin B-22 EW10-B22-MH01 | Basin B-24 EW10-B24-MH01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hexachloroethane | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| Isophorone | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 45 | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| n-Nitroso-di-n-propylamine | nv | nv | µg/kg dw | 30 U | 30 U | 30 U | 500 UJ | 30 U | 30 U | 31 U | 30 U | 30 U | 30 U | 32 U | 90 U | 30 U |
| n-Nitrosodimethylamine | nv | nv | µg/kg dw | 30 U | 30 U | 30 U | na | 30 U | 30 U | 31 U | 30 U | 30 U | 30 U | 32 U | 90 U | 30 U |
| n-Nitrosodiphenylamine | 28 | 40 | µg/kg dw | 6.1 U | 12 | **30 J** | **100 U** | 6.1 U | 6.0 U | **39 J** | **29 J** | 13 | 7.3 J | **41 J** | 20 | **39** |
| Nitrobenzene | nv | nv | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| Pentachlorophenol | 360 | 690 | µg/kg dw | 30 U | 30 U | 30 U | **500 UJ** | 30 U | 30 U | 31 U | 30 U | 30 U | 30 U | 32 U | 90 U | 30 U |
| Phenol | 420 | 1,200 | µg/kg dw | 73 U | 40 UJ | 91 UJ | 100 UJ | 39 U | 39 U | 95 U | 84 U | 39 U | 39 U | 120 U | 51 U | 91 U |
| **PCBs** | | | | | | | | | | | | | | | | |
| Aroclor-1016 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 31 U | 31 U | 33 U | 55 U | 30 U | 31 U | 32 U | 31 U | 31 U | 32 U |
| Aroclor-1221 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 31 U | 31 U | 33 U | 55 U | 30 U | 31 U | 32 U | 31 U | 31 U | 32 U |
| Aroclor-1232 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 31 U | 31 U | 33 U | 55 U | 30 U | 31 U | 32 U | 31 U | 31 U | 32 U |
| Aroclor-1242 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 31 U | 31 U | 33 U | 55 U | 30 U | 31 U | 32 U | 31 U | 31 U | 32 U |
| Aroclor-1248 | nv | nv | µg/kg dw | 66 | 32 U | 80 U | 78 U | 31 U | 33 U | 280 U | 30 U | 31 U | 32 U | 31 U | 31 U | 79 U |
| Aroclor-1254 | nv | nv | µg/kg dw | 120 | 32 U | 290 | 290 | 31 U | 33 U | 2,300 | 30 U | 31 U | 32 U | 78 U | 31 U | 390 U |
| Aroclor-1260 | nv | nv | µg/kg dw | 76 | 40 | 160 | 140 | 31 U | 33 U | 480 | 30 U | 31 U | 32 U | 170 | 31 U | 1,200 |
| Aroclor-1262 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 31 U | 31 U | 33 U | 55 U | 30 U | 31 U | 32 U | 31 U | 31 U | 32 U |
| Aroclor-1268 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 31 U | 31 U | 33 U | 55 U | 30 U | 31 U | 32 U | 31 U | 31 U | 32 U |
| Total PCBs | 130 | 1,000 | µg/kg dw | **260** | 40 | **450** | **430** | 31 U | 33 U | **2,800** | 30 U | 31 U | 32 U | **170** | 31 U | **1,200** |
| **Petroleum hydrocarbons** | | | | | | | | | | | | | | | | |
| TPH – diesel range | nv | nv | mg/kg dw | 550 J | 140 J | 450 J | 530 J | 28 J | 8.6 J | 480 J | 400 J | 110 J | 230 J | 610 J | 210 J | 390 J |
| TPH – oil range | nv | nv | mg/kg dw | 2,200 | 900 | 3,300 | 2,700 | 220 | 45 | 3,100 | 3,300 | 630 | 840 | 3,600 | 1,400 | 2,500 |
| TPH | nv | nv | mg/kg dw | 2,800 J | 1,040 J | 3,800 J | 3,200 J | 250 J | 54 J | 3,600 J | 3,700 J | 740 J | 1,070 J | 4,200 J | 1,600 J | 2,900 J |
| **Organic carbon** | | | | | | | | | | | | | | | | |
| TOC | nv | nv | % dw | 3.31 | 3.96 | 6.41 | 4.59 | 2.19 | 1.10 | 7.59 | 6.03 | 3.58 | 2.73 | 6.27 | 5.89 | 6.90 |

[a] Sample EW10-B21-MH01 was mislabeled in the field as EW10-B20-MH01.

Concentration in **bold** indicates an LAET exceedance.

Concentration in **bold underline** indicates a 2LAET exceedance.

2LAET – second-lowest apparent effects threshold
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
J – estimated concentration
LAET – lowest apparent effects threshold
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
nv – no value
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH – total petroleum hydrocarbons
U – not detected at given concentration

## Table 6. Terminals 30, 25, and 104 near-end-of-pipe in-line solids chemical analyses results

| Chemical | LAET | 2LAET | Unit | Basin B-26 | Basin B-27 | Basin B-29 | Basin B-30 | Basin B-31 | Basin B-32 | Basin B-33 | Basin B-34 | Basin B-37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EW10-B26-MH01 | EW10-B27-MH01 | EW10-B29-MH01 | EW10-B30-MH01 | EW10-B31-MH01 | EW10-B32-MH01 | EW10-B33-MH01 | EW10-B34-MH01 | EW10-B37-MH01 |
| **Metals** | | | | | | | | | | | | |
| Arsenic | 57 | 93 | mg/kg dw | 10 | 7 | 20 U | 23 | 15 | 20 | 11 | **88** | 30 U |
| Cadmium | 5.1 | 6.7 | mg/kg dw | 0.8 | 0.4 | 0.6 U | 1.9 | 0.9 | 2.0 | 1.1 | **12.4** | 3 |
| Chromium | 260 | 270 | mg/kg dw | 80 | 45.2 J | 72 J | 39.2 J | 44.8 | 57 | 55.6 | 111 | 146 |
| Copper | 390 | 390 | mg/kg dw | 78.4 | 55.4 | **1,600** | 203 | 142 | 132 | 93.2 | 298 | 227 |
| Lead | 450 | 530 | mg/kg dw | 247 | 76 J | 94 J | 157 J | 52 | 95 | 84 | **2,590** | 430 |
| Mercury | 0.41 | 0.59 | mg/kg dw | 0.1 | 0.08 J | 0.05 J | **0.47 J** | 0.03 | 0.04 | 0.09 | **1.27** | **0.45** |
| Silver | 6.1 | nv | mg/kg dw | 0.6 U | 0.4 U | 0.9 U | 0.4 U | 0.4 U | 1 U | 0.4 U | 1.4 | 2 U |
| Zinc | 410 | 960 | mg/kg dw | **690** | **2,120 J** | **420 J** | **554 J** | **1,520** | **1,330** | **1,040** | **2,710** | **1,100** |
| **PAHs** | | | | | | | | | | | | |
| 1-Methylnaphthalene | nv | nv | µg/kg dw | 16 J | 120 U | 58 U | 59 U | 25 U | 18 J | 15 J | 300 | 2,100 |
| 2-Chloronaphthalene | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| 2-Methylnaphthalene | 670 | 670 | µg/kg dw | 25 J | 120 U | 58 U | 44 J | 25 U | 27 | 15 J | 400 | **1,600** |
| Acenaphthene | 500 | 500 | µg/kg dw | 29 U | 120 U | 56 J | 110 | 16 J | 15 J | 43 | 280 U | 130 U |
| Acenaphthylene | 1,300 | 1,300 | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 22 J | 25 U | 29 | 280 U | 130 U |
| Anthracene | 960 | 960 | µg/kg dw | 31 | 69 J | 140 | 240 | 92 | 49 | 130 | 280 U | 130 U |
| Benzo(a)anthracene | 1,300 | 1,600 | µg/kg dw | 110 | 140 | 280 | 1,300 | 260 | 150 | 210 | 620 J | **1,400** |
| Benzo(a)pyrene | 1,600 | 1,600 | µg/kg dw | 150 | 200 | 420 | **2,300** | 390 | 140 | 230 | 710 | 930 |
| Benzo(g,h,i)perylene | 670 | 720 | µg/kg dw | 89 | 140 | 200 | **870** | 160 | 73 | 110 | 640 | **680** |
| Total benzofluoranthenes | 3,200 | 3,600 | µg/kg dw | 360 | 340 | 840 | **3,600** | 960 | 380 | 660 | 1,220 | 2,200 |
| Chrysene | 1,400 | 2,800 | µg/kg dw | 270 | 330 | 660 | **1,900** | 570 | 320 | 500 | **2,300** | 810 |
| Dibenzo(a,h)anthracene | 230 | 230 | µg/kg dw | 23 J | 120 U | 54 J | **290** | 55 | 20 J | 24 J | 190 J | 160 |
| Dibenzofuran | 540 | 540 | µg/kg dw | 29 U | 120 U | 39 J | 59 | 25 U | 14 J | 34 | 280 U | 130 U |
| Fluoranthene | 1,700 | 2,500 | µg/kg dw | 290 | 440 | 1,600 | **2,500** | 870 | 630 | 1,200 | 810 | **3,200** |
| Fluorene | 540 | 540 | µg/kg dw | 29 U | 120 | 83 | 72 | 28 | 22 J | 64 | 280 U | **1,000** |
| Indeno(1,2,3-cd)pyrene | 600 | 690 | µg/kg dw | 55 | 89 J | 190 | **830** | 120 | 44 | 71 | 270 J | 480 |
| Naphthalene | 2,100 | 2,100 | µg/kg dw | 17 J | 120 U | 58 U | 95 | 19 J | 74 | 16 J | 280 U | 640 |
| Phenanthrene | 1,500 | 1,500 | µg/kg dw | 95 | 370 | 690 | 1,000 | 210 | 250 | 400 | 470 | **2,800** |
| Pyrene | 2,600 | 3,300 | µg/kg dw | 300 | 370 | 1,100 | 2,000 | 310 | 340 | 520 | 1,200 | 2,200 |
| Total HPAHs | 12,000 | 17,000 | µg/kg dw | 1650 J | 2050 J | 5300 J | **15,600** | 3,700 | 2100 J | 3500 J | 8000 J | **12,100** |
| Total LPAHs | 5,200 | 5,200 | µg/kg dw | 143 J | 560 J | 970 J | 1,500 | 390 J | 410 J | 680 J | 470 | 4,400 |
| cPAHs - mammal - half DL | nv | nv | µg/kg dw | 210 J | 280 J | 580 J | 3,000 | 550 | 210 J | 340 J | 1000 J | 1,400 |
| Total PAHs | nv | nv | µg/kg dw | 1790 J | 2610 J | 6300 J | 17,100 | 4080 J | 2510 J | 4200 J | 8400 J | 16,500 |
| **Phthalates** | | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 1,300 | 1,900 | µg/kg dw | 1,200 | **2,000 J** | **3,000** | 820 | **4,300** | **5,200** | **1,800** | **3,600** | **10,000** |
| Butyl benzyl phthalate | 63 | 900 | µg/kg dw | **100** | 36 | **130** | 38 | **1,200** | **610** | **1,300** | **1,800** | **2,500** |
| Diethyl phthalate | 200 | nv | µg/kg dw | 29 U | 15 U | 32 | 15 U | 25 U | 25 U | 28 U | 160 U | 86 U |
| Dimethyl phthalate | 71 | 160 | µg/kg dw | 29 U | 15 U | 15 U | 15 U | 25 U | 19 J | 28 U | **8,200** | **86 U** |

| Chemical | LAET | 2LAET | Unit | Basin B-26<br>EW10-B26-MH01 | Basin B-27<br>EW10-B27-MH01 | Basin B-29<br>EW10-B29-MH01 | Basin B-30<br>EW10-B30-MH01 | Basin B-31<br>EW10-B31-MH01 | Basin B-32<br>EW10-B32-MH01 | Basin B-33<br>EW10-B33-MH01 | Basin B-34<br>EW10-B34-MH01 | Basin B-37<br>EW10-B37-MH01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Di-n-butyl phthalate | 1,400 | 1,400 | µg/kg dw | 29 U | 120 U | 53 J | 98 | 92 | 23 J | 47 | **1,600** | 130 U |
| Di-n-octyl phthalate | 6,200 | nv | µg/kg dw | 29 U | 120 U | 56 J | 33 J | 25 U | 720 | 28 U | 280 U | 130 U |
| **Other SVOCs** | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 31 | 51 | µg/kg dw | 19 U | 5.9 U | 5.8 U | 6.0 U | 18 U | 18 U | 18 U | 30 U | **34 U** |
| 1,2-Dichlorobenzene | 35 | 50 | µg/kg dw | 19 U | 5.9 U | 5.8 U | 6.0 U | 18 U | 18 U | 18 U | **61** | 34 U |
| 1,3-Dichlorobenzene | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| 1,4-Dichlorobenzene | 110 | 110 | µg/kg dw | 19 U | 5.9 J | 6.4 J | 7.8 J | 18 U | 18 U | 18 U | 30 | 34 U |
| 2,4,5-Trichlorophenol | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 2,4,6-Trichlorophenol | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 2,4-Dichlorophenol | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 2,4-Dimethylphenol | 29 | 29 | µg/kg dw | 19 U | 5.9 U | 5.8 U | 6.0 U | 18 U | 18 U | 18 U | **30 U** | **48 U** |
| 2,4-Dinitrophenol | nv | nv | µg/kg dw | 290 U | 1,200 U | 580 U | 590 U | 250 U | 250 U | 280 U | 2,800 U | 1,300 U |
| 2,4-Dinitrotoluene | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 2,6-Dinitrotoluene | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 2-Chlorophenol | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| 2-Methylphenol | 63 | 63 | µg/kg dw | 19 U | 5.9 U | 5.8 U | 6.0 U | 18 U | 18 U | 18 U | 30 U | 34 U |
| 2-Nitroaniline | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 2-Nitrophenol | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| 3,3'-Dichlorobenzidine | nv | nv | µg/kg dw | R | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 3-Nitroaniline | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 4,6-Dinitro-o-cresol | nv | nv | µg/kg dw | 290 U | 1,200 U | 580 U | 590 U | 250 U | 250 U | 280 U | 2,800 U | 1,300 U |
| 4-Bromophenyl phenyl ether | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| 4-Chloro-3-methylphenol | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 4-Chloroaniline | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 4-Chlorophenyl phenyl ether | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| 4-Methylphenol | 670 | 670 | µg/kg dw | 29 UJ | 120 U | 58 U | 59 U | 25 UJ | 25 UJ | 28 UJ | 280 UJ | **2,400 J** |
| 4-Nitroaniline | nv | nv | µg/kg dw | 140 U | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| 4-Nitrophenol | nv | nv | µg/kg dw | R | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| Aniline | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| Benzoic acid | 650 | 650 | µg/kg dw | 290 UJ | **1,200 U** | 580 U | 590 U | 110 J | 110 J | 280 U | **740 J** | **1,300 U** |
| Benzyl alcohol | 57 | 73 | µg/kg dw | 29 U | 30 U | 29 U | 30 U | 56 | **490** | 28 U | **150 U** | **130 U** |
| bis(2-chloroethoxy)methane | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| bis(2-chloroethyl)ether | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| bis(2-chloroisopropyl)ether | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| Carbazole | nv | nv | µg/kg dw | 29 U | 120 U | 110 | 160 | 20 J | 41 | 34 | 280 U | 130 U |
| Hexachlorobenzene | 22 | 70 | µg/kg dw | 19 U | 5.9 U | 5.8 U | 6.0 U | 18 U | 18 U | 18 U | **30 U** | **34 U** |
| Hexachlorobutadiene | 11 | 120 | µg/kg dw | **19 U** | 5.9 U | 5.8 U | 6.0 U | **18 U** | **18 U** | **18 U** | **30 U** | **34 U** |
| Hexachlorocyclopentadiene | nv | nv | µg/kg dw | R | 600 U | 290 U | 300 U | 130 U | 120 U | 140 U | 1,400 U | 630 U |
| Hexachloroethane | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| Isophorone | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 16 J | 280 U | 130 U |

| Chemical | LAET | 2LAET | Unit | Basin B-26 EW10-B26-MH01 | Basin B-27 EW10-B27-MH01 | Basin B-29 EW10-B29-MH01 | Basin B-30 EW10-B30-MH01 | Basin B-31 EW10-B31-MH01 | Basin B-32 EW10-B32-MH01 | Basin B-33 EW10-B33-MH01 | Basin B-34 EW10-B34-MH01 | Basin B-37 EW10-B37-MH01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n-Nitroso-di-n-propylamine | nv | nv | µg/kg dw | 93 U | 30 U | 29 U | 30 U | 90 U | 92 U | 90 U | 150 U | 170 U |
| n-Nitrosodimethylamine | nv | nv | µg/kg dw | 93 U | 30 U | 29 U | 30 U | 90 U | 92 U | 90 U | 150 U | 170 U |
| n-Nitrosodiphenylamine | 28 | 40 | µg/kg dw | **<u>63</u>** | 12 J | 8.2 U | 13 J | **29** | 22 | 18 U | **<u>110</u>** | **<u>130 U</u>** |
| Nitrobenzene | nv | nv | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| Pentachlorophenol | 360 | 690 | µg/kg dw | 93 U | 30 U | 29 U | 30 U | 90 U | 92 U | 90 U | 150 U | 170 U |
| Phenol | 420 | 1,200 | µg/kg dw | 29 U | 120 U | 58 U | 59 U | 25 U | 25 U | 28 U | 280 U | 130 U |
| **PCBs** | | | | | | | | | | | | |
| Aroclor-1016 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 87 U | 33 U |
| Aroclor-1221 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 87 U | 33 U |
| Aroclor-1232 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 87 U | 33 U |
| Aroclor-1242 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 87 U | 33 U |
| Aroclor-1248 | nv | nv | µg/kg dw | 60 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 1,000 U | 87 U |
| Aroclor-1254 | nv | nv | µg/kg dw | 120 | 32 U | 32 U | 33 U | 49 | 38 | 62 | 4,100 | 92 |
| Aroclor-1260 | nv | nv | µg/kg dw | 35 | 32 U | 32 U | 36 | 54 | 55 | 110 | 6,000 | 88 |
| Aroclor-1262 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 87 U | 33 U |
| Aroclor-1268 | nv | nv | µg/kg dw | 33 U | 32 U | 32 U | 33 U | 32 U | 32 U | 32 U | 87 U | 33 U |
| Total PCBs | 130 | 1,000 | µg/kg dw | **160** | 32 U | 32 U | 36 | 103 | 93 | **170** | **<u>10,100</u>** | **180** |
| **Petroleum hydrocarbons** | | | | | | | | | | | | |
| TPH - diesel range | nv | nv | mg/kg dw | 140 | 150 | 130 | 120 | 70 J | 46 J | 100 J | 940 | 2,800 |
| TPH - oil range | nv | nv | mg/kg dw | 500 | 1,300 | 930 | 680 | 640 | 470 | 760 | 2,800 | 6,000 |
| TPH | nv | nv | mg/kg dw | 640 | 1,500 | 1,060 | 800 | 710 J | 520 J | 860 J | 3,700 | 8,800 |
| **Organic carbon** | | | | | | | | | | | | |
| TOC | nv | nv | % dw | 4.50 | 4.43 | 2.73 | 2.90 | 3.85 | 3.74 | 4.82 | 7.37 | 8.61 |

Concentration in **bold** indicates an LAET exceedance.

Concentration in **<u>bold underline</u>** indicates a 2LAET exceedance.

2LAET – second-lowest apparent effects threshold
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
J – estimated concentration
LAET – lowest apparent effects threshold
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
nv – no value
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH – total petroleum hydrocarbons
U – not detected at given concentration

### Table 7. In-line solids dioxin/furan analyses results

| | | EW10-B16-MH01 | EW10-B34-MH01 | EW10-MH-comp1 | EW10-MH-comp2 | EW10-MH-comp3 | EW10-MH-comp4 | EW10-MH-comp5 | EWWST7-040110-comp | EW10-B1-MH01 | EW10-B37-MH01 | EW10-B21-MH01 | EW10-B22-MH01 | EW10-Bcomp-MH01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **Unit** | **Basin B-16** | **Basin B-34** | **Basins B-1, B-37** | **Basins B-7, B-10, B-12, B-13, B-14** | **Basins B-17, B-18, B-19, B-21, B-22, B-24** | **Basins B-31, B-32, B-33** | **Basins B-26, B-27, B-29, B-30** | **Basin B-11** | **Basin B-1** | **Basin B-37** | **Basin B-21** | **Basin B-22** | **Basins B-17, B-18, B-19** |
| 2,3,7,8-TCDD | ng/kg dw | 1.37 | 8.85 | 4.53 | 0.263 U | 0.755 | 0.305 J | 0.476 U | 2.32 | 5.97 | 3.21 | 0.680 U | 0.262 J | 0.129 J |
| 1,2,3,7,8-PeCDD | ng/kg dw | 7.33 | 115 | 28.3 | 1.10 J | 5.78 | 1.39 J | 2.61 | 11.0 | 54.6 | 16.0 | 5.42 | 1.31 J | 0.583 J |
| 1,2,3,4,7,8-HxCDD | ng/kg dw | 12.5 | 264 | 42.6 | 1.57 J | 13.6 | 2.49 J | 4.24 | 20.1 | 63.0 | 19.8 | 9.76 | 1.84 J | 0.805 J |
| 1,2,3,6,7,8-HxCDD | ng/kg dw | 38.7 | 986 | 129 | 6.20 | 48.8 | 6.54 | 10.5 | 47.9 | 154 | 75.3 | 26.3 | 6.55 | 2.32 |
| 1,2,3,7,8,9-HxCDD | ng/kg dw | 26.4 | 602 | 91.0 | 3.02 | 29.7 | 4.33 | 8.51 | 38.7 | 140 | 37.0 | 20.2 | 3.99 | 1.64 J |
| 1,2,3,4,6,7,8-HpCDD | ng/kg dw | 885 | 23,100 J | 2,690 | 120 | 1,290 | 238 | 223 | 1,110 | 2,690 | 2,290 | 595 | 103 | 47.0 |
| OCDD | ng/kg dw | 6,530 | 149,000 J | 19,300 J | 934 | 9,370 | 1,660 | 1,450 | 7,900 | 14,800 J | 21,600 J | 4,280 | 673 | 348 |
| 2,3,7,8-TCDF | ng/kg dw | 16.8 | 119 | 11.4 | 1.59 | 7.34 | 1.77 | 3.09 | 15.1 | 8.25 | 17.0 | 6.79 | 2.68 | 0.922 |
| 1,2,3,7,8-PeCDF | ng/kg dw | 9.92 | 78.5 | 7.99 | 0.927 J | 5.41 | 0.977 J | 1.71 J | 16.9 | 8.94 | 9.82 | 5.50 | 2.24 J | 0.627 U |
| 2,3,4,7,8-PeCDF | ng/kg dw | 22.9 | 201 | 16.9 | 2.18 J | 10.6 | 2.28 J | 4.75 | 40.5 | 19.0 | 18.6 | 9.00 | 3.43 | 1.24 J |
| 1,2,3,4,7,8-HxCDF | ng/kg dw | 21.4 | 377 | 22.1 | 2.05 J | 12.8 | 2.45 J | 3.98 | 73.2 | 21.9 | 23.4 | 9.11 | 3.11 | 0.933 U |
| 1,2,3,6,7,8-HxCDF | ng/kg dw | 17.1 | 188 | 22.2 | 1.92 J | 10.5 | 1.85 J | 3.34 | 51.6 | 30.1 | 13.9 | 6.87 | 2.49 | 0.928 J |
| 1,2,3,7,8,9-HxCDF | ng/kg dw | 2.45 U | 2.49 U | 2.47 U | 2.46 U | 2.49 U | 2.50 U | 2.41 U | 2.50 U | 2.39 U | 8.87 | 2.36 U | 2.48 U | 2.31 U |
| 2,3,4,6,7,8-HxCDF | ng/kg dw | 22.6 | 277 | 32.3 | 2.46 | 14.3 | 2.46 J | 4.94 | 84.6 | 42.9 | 14.0 | 10.0 | 3.28 | 1.22 J |
| 1,2,3,4,6,7,8-HpCDF | ng/kg dw | 195 | 3,550 | 355 | 22.8 | 218 | 27.7 | 45.0 | 817 | 334 | 441 | 107 | 20.9 | 8.98 |
| 1,2,3,4,7,8,9-HpCDF | ng/kg dw | 12.2 | 239 | 18.9 | 1.70 J | 12.0 | 1.91 J | 3.06 | 83.8 | 13.9 | 32.1 | 6.93 | 1.72 J | 0.647 J |
| OCDF | ng/kg dw | 409 | 6,620 | 943 | 102 | 492 | 97.6 | 90.7 | 2,260 | 340 | 2,150 | 240 | 33.6 | 18.2 |
| Dioxin/furan TEQ – mammal (half DL) | ng/kg dw | 44.5 | 784 J | 110 J | 5.67 J | 41.9 | 7.93 J | 11.5 J | 82.4 | 148 J | 80.8 J | 26.1 | 6.65 J | 2.72 J |

DL – detection limit
dw – dry weight
HpCDD – heptachlorodibenzo-*p*-dioxin
HpCDF – heptachlorodibenzofuran
HxCDD – hexachlorodibenzo-*p*-dioxin
HxCDF – hexachlorodibenzofuran
J – estimated concentration
OCDD – octachlorodibenzo-*p*-dioxin
OCDF – octachlorodibenzofuran
PeCDD – pentachlorodibenzo-*p*-dioxin
PeCDF – pentachlorodibenzofuran
TCDD – tetrachlorodibenzo-*p*-dioxin
TCDF – tetrachlorodibenzofuran
TEQ – toxic equivalent
U – not detected at given concentration

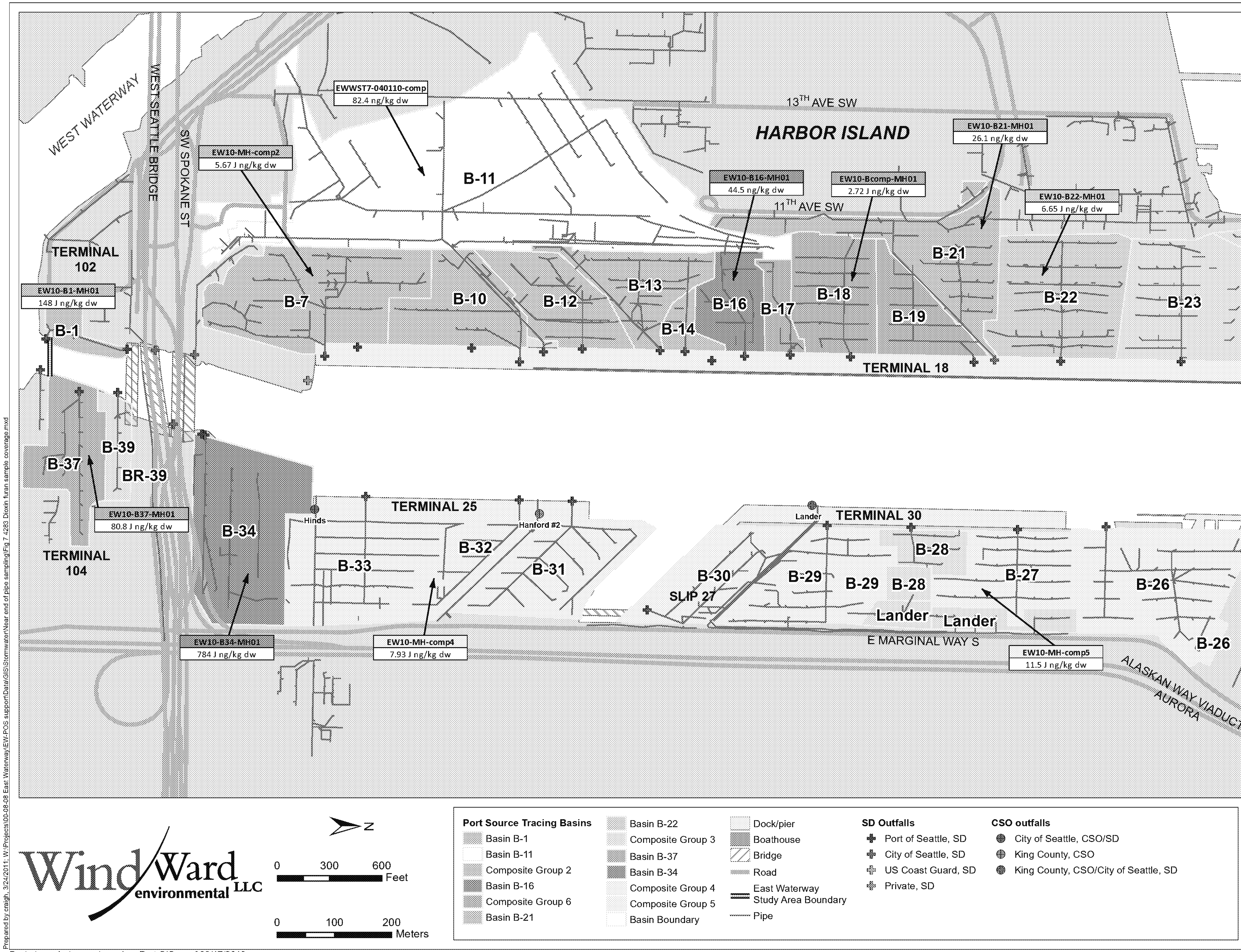



**Figure 7. Dioxin/furan TEQ results**

Prepared by craigh, 3/24/2011; W:\Projects\00-08-08 East Waterway\EW-POS support\Data\GIS\Stormwater\Near end of pipe sampling\Fig 7 4283 Dioxin furan sample coverage.mxd

Basin boundaries are based on Port GIS as of 06/17/2010.

## 5 Data Validation

Data quality objectives and laboratory quality control procedures are discussed in Sections 2.5 and 3.5, respectively, of the QAPP (Windward 2010). The dioxin/furan samples were submitted to AP and analyzed in three sample delivery groups (SDGs): P2387, P2621, and A2866. The other in-line solids samples were submitted to ARI and analyzed in four SDGs: QT48, QU06, QZ09, and QZ39. EcoChem performed independent full-level data validation on SDGs P2387 and A2866, and independent summary-level data validation on all other results. The summary-level data validation included a review of all QC summary forms, including initial and continuing calibration, internal standard, surrogate, laboratory control sample (LCS), laboratory control sample duplicate (LCSD), matrix spike (MS), matrix spike duplicate (MSD), and interference check sample summary forms. In addition to the summary-level validation requirements, full-level data validation includes recalculation of instrument and sample results from instrument responses and evaluation of instrument outputs for analyte identification and quantitation. The majority of the data did not require qualification, or were qualified with a J, indicating an estimated value. Three SVOC results were rejected as a result of data validation, and these results will not be used for any purpose. The QAPP-specified completeness goal of 95% was met.

Based on the information reviewed, the overall data quality was considered acceptable for use as qualified. Issues that resulted in the qualification of data are summarized below. Detailed information regarding every qualified sample is presented in Appendix C.

- Three non-detected results for three SVOC chemicals were rejected by the data validator because of extremely low LCS/LCSD or MS/MSD recoveries (i.e., less than 10%). The rejected data include non-detected results for hexachlorocyclopentadiene, 4-nitrophenol, and 3,3-dichlorobenzidine in sample EW10-B26-MH01. Rejected data will not be used for any purpose.
- In the EPA 8270D analysis, internal standard recoveries were above QC limits for chrysene-d12 in two samples and for perylene-d12 in four samples. Internal standard recoveries were below QC limits for phenanthrene-d10 in one sample, for acenaphthene-d10 in three samples, for perylene-d12 in one sample, for 1,4-dichlorobenzene-d4 in three samples, and for naphthalene-d8 in three samples. The low internal standard recoveries resulted in the J- (estimated concentration) or UJ- (not detected at given estimated concentration) qualification of the associated chemicals in these samples.
- In the EPA 8270D selective ion monitoring (SIM) analysis, internal standard recoveries were below QC limits for chrysene-d12 in two samples, and above QC limits for phenanthrene-d10 in six samples and for acenaphthene-d10 in one sample. The low internal standard recoveries resulted in the J- (estimated

concentration) or UJ- (not detected at given estimated concentration) qualification of the associated chemicals in these samples.

- Seven detected results for phenol and one detected result for bis(2-ethylhexyl)phthalate were U-qualified (not detected at given concentration) because of method blank contamination.
- The percent difference for the continuing calibration was greater than the control limit of 25% for pentachlorophenol in SDG QU06. Consequently, all results for this chemical in QU06 were UJ-qualified (not detected at given estimated concentration).
- The percent difference for the continuing calibration performed on May 6, 2010, was greater than the control limit of 25% for butylbenzylphthalate in sample EW10-B22-MH01. Consequently, the result for this chemical in EW10-B22-MH01 was J-qualified (estimated concentration).
- Twenty-one results for various PAHs, phthalates, and other SVOC chemicals were J-qualified (estimated concentration) because of MS or LCS recoveries outside of control limits. One result for chromium in sample EW10-B27-MH01 was J-qualified due to low MS recovery.
- Results for Aroclor 1248 in seven samples and for Aroclor 1254 in two samples were Y-qualified (elevated reporting limit [RL]) by the laboratory as non-detects. The Y-qualifier indicates that chromatographic interference in the sample prevented adequate resolution of the compound at the standard RLs. These Y-qualified results were U-qualified (not detected at given concentration) by the validator. Elevated RLs were also reported for n-nitrosodiphenylamine in two samples and for 2,4-dimethylphenol in one sample.
- Results for diesel-range hydrocarbons for all samples were J-qualified (estimated concentration), because the sample chromatograms did not match the standard chromatograms.
- At the retention times for benzo(b)fluoranthene and benzo(k)fluoranthene, a single peak was present. The laboratory used half of the peak area to calculate a concentration for benzo(b)fluoranthene, and the other half to calculate a concentration for benzo(k)fluoranthene. Since it is not possible to determine whether only one or both analytes were present, the positive results for these analytes were NJ-qualified (tentatively identified at an estimated concentration).
- Chromium results from SDG QZ09 were J-qualified (estimated concentration) because of recoveries above 130% of the DL standard.
- Results for lead, mercury, and zinc from SDG QZ09 were J-qualified (estimated concentration) because of laboratory duplicate results outside of control limits.

- Results for octachlorodibenzo-*p*-dioxin (OCDD) from samples EW10-MH-comp1, EW10-B34-MH01, and EW10-B1-MH01, and for 1,2,3,4,6,7,8-heptachlorodibenzo-*p*-dioxin (HpCDD) from sample EW10-B34-MH01, were J-qualified (estimated concentration) because the results exceeded the linear calibration range of the instrument.
- Thirty-one results for various dioxin/furan congeners were J-qualified (estimated concentration) because the concentrations were detected below the RL.

# 6 Post-sampling Cleanouts

The drainage lines of basin B-7 were cleaned out with a vactor truck in October 2010, as described in the EW stormwater basins B-7 and B-32 post-cleanout solids sampling results report (Windward in prep). The catch basins of basin B-7 had been cleaned out in December 2009 as a source control effort to address elevated levels of PAHs in the catch basin solids. The cleanout of the drainage lines was subsequently conducted in October 2010 to complete the cleanout of the drainage network.

The drainage lines and catch basins of basin B-34 were cleaned out by the Port to address the elevated levels of contaminants measured in the solids sample collected from the maintenance hole nearest the outfall. The extent of the cleanout is shown in Figure 8. Solids and wastewater from the cleanout were stored on-site until the waste was characterized for disposal. During the cleanout of the network, an object described as a "greasy plug" was encountered in the main drainage line. The object was removed from the line by the cleaning crew. Cleaning logs, waste profiles, and disposal receipts from the basin B-34 cleanout are provided in Appendix F.

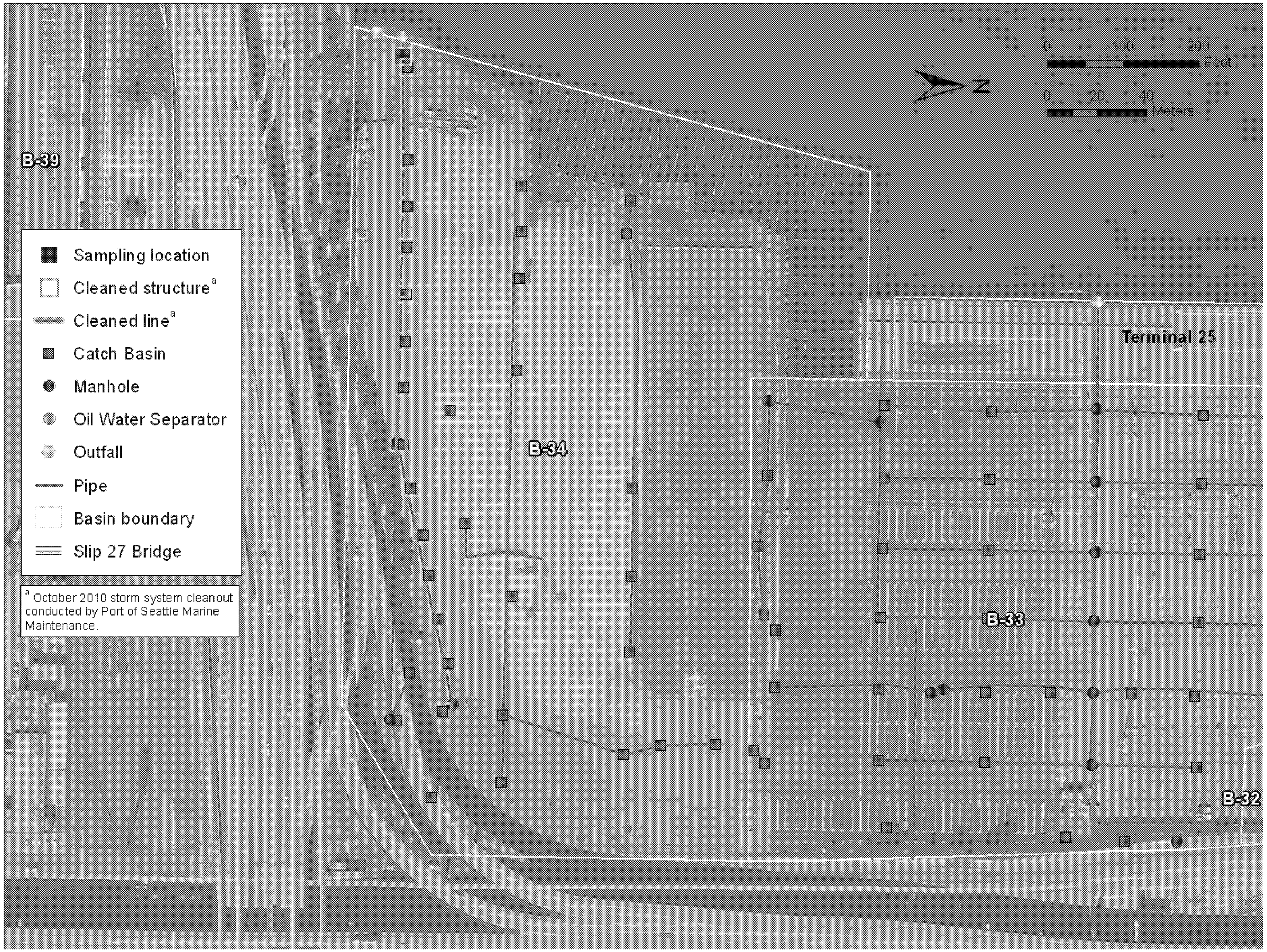



**Figure 8. Basin B-34 cleanout extent**

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